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In a study designed to investigate the relative effectiveness of three methods of television utilization, 817 fifth grade students were exposed to 12 telelessons on a science unit about insects. With one group of students, the teachers were instructed to use a Socratic approach, ask questions and give immediate knowledge of correct responses. In another group the teachers explained that the students had had no opportunity for a question-answer session. With the third control group the teachers were provided with a program guide and left to their own devices. Data collected included: standardized pretest scores of science knowledge, intelligence scores, posttest scores of learning from the television lessons, and certain background information for each child. The data from this experiment suggests primarily that teachers be taught to use the Socratic method of instructional television utilization. Teachers should plan to create a classroom context beneficial to instructional television by involving their students in the lesson and encouraging them to respond actively to questions about the content. Data analysis of the primary and some of the secondary findings of the study is provided and some probable causes for the results are discussed. Appendices include three sets of teacher instructions, sample tests, and questionnaires. (JY)

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FINAL REPORT
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THE EFFECT OF DIFFERENT TELEVISION UTILIZATION PROCEDURES ON STUDENT LEARNING

April 1968

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Serena E. Wade

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Santa Clara County Office of Education

San Jose, California

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THE EFFECT OF DIFFERENT TELEVISION UTILIZATION PROCEDURES ON STUDENT LEARNING

INTRODUCTION

Study Background

As part of their evaluation of the first year of Peace Corps Educational Television in Colombia, Maccoby and Comstock (1965) designed an experiment which dealt with the kind of in-class methods the teacher should be encouraged to use in connection with television. On the basis of a whole series of previous researches done mostly in quasi-laboratory settings and in American classrooms, Maccoby and Comstock concluded that a demonstration of material to be learned which is accompanied by appropriate patterns of active student participation of content increases learning efficiency (Lumsdaine, 1963). Of the possible combinations of demonstration, the method of providing students with knowledge of correct responses was highly effective (Michael and Maccoby, 1953; Maccoby and Sheffield, 1961).

From this previous work, three demonstration-learning propositions were advanced:

Added exposure to the material to be learned increases learning;

Practice by the learner of the content to be learned increases learning; and

Feedback of the correct responses to the learner increases learning.

In the Colombian study, Peace Corps volunteers trained teachers in two types of preparation and follow-up for classroom television programs, Socratic and Teacher-Tell. The Socratic method involved question and answer discussions with the students; students were given immediate knowledge of correct responses. The Teacher-Tell method was a brief lecture given by the teacher to prepare students for the TV lesson and a short summary, again given by the teacher, as follow-up for the TV lesson; no question and answer periods and no immediate feedback of the correct responses were involved. An Ad Hoc method of utilization was used as a control condition. Here the teachers were given no special instructions on utilization and were left to their own devices on preparation and follow-up.

After pretesting for feasibility of both training procedures and printed materials developed for the experiment, these hypotheses were put forth:

1. Socratic would prove superior to Ad Hoc utilization because of (a) exposure to more relevant material, (b) feedback of correct and incorrect responses, and (c) insured practice.

2. Socratic would prove superior to Teacher-Tell because of (a) insured perception of content and (b) insured practice of correct responses.

The experimental design included two subject areas, fourth grade natural sciences and fifth grade mathematics. Six Peace Corps volunteers supervised teachers in each area of utilization so that effects of variations in volunteer skills would be evenly distributed over all experimental conditions.

After approximately four weeks during which the teachers used the experimental procedures, Maccoby and Comstock obtained learning scores for 29 classes, representing the performance of over 850 pupils. Conventional t-tests between grouped class means supported the first hypothesis of the study in both natural science ($p < .005$) and mathematics ($p < .05$). The second hypothesis was not supported at better than the .05 level, although differences between grouped class means were in the expected direction for both subject areas.

In their discussion of the results, Maccoby and Comstock suggest the superiority of the Socratic method demonstrates:

> . . . the importance of instructing teachers to elicit individual responses from their pupils which can be immediately reinforced by providing the correct answer. Such a procedure evidently enhances the likelihood of further correct practice. The exchange of questions and answers in the context in which each pupil offers up his answer independently, as in the Socratic form used in the experiment, would seem to be an excellent means of accomplishing this.
>
> . . . The meaning of the results would seem to be: the classroom effectiveness of teachers <u>can</u> be improved through simple changes in their methods -- in what is called "utilization" of ETV -- and the introducing of these changes can be enhanced through the provision of suitable guide materials.

This experiment needed replication and the results deserved elaboration in the United States, in a community where television is not a novelty, as it was in Colombia, and where the level of schooling and teacher preparation is already much higher than in Colombia.

Problem and Design

Recent discussion of utilization measurement in educational journals indicates a prevailing confusion between "utilization" as method effectiveness or extent of use (Twyford, 1961). In fact, all data on utilization prior to 1960 concentrated solely on sets in use; since then, more attention has been given to methodological implications of instructional TV. Researchers have indicated that the systematic use of television requires some relinquishment of the teacher's curriculum autonomy and a redefinition of her instructional role to a "manager of learning situations" and/or "counselor of individual learners" rather than a simple medium of dissemination (Tyler, 1962).

However, in a survey of elementary teachers using the ETV services of MPATI, Guba and Snyder (1965) found that the classroom teacher is little affected by the introduction of instructional television and that patterns of utilization remain conventional and stereotyped. The authors concluded: (a) TV is used as a replacement for the telling-showing function; (b) there is no tendency for preparation or follow-up to be parallel or developmental in nature; and (c) the TV lesson is used as an interlude or break in the usual classroom routine with resumption of previous (often unrelated) activities when the lesson is over. Clearly, say the authors, some form of in-service training for TV utilization is indicated.

The purpose of this project, then, was to study systematically the learning by fifth grade students that resulted from exposure to a unit on insects and animals from an instructional TV series entitled Exploring with Science* shown during school hours when teachers preceded and followed the lessons in a controlled fashion, using materials designed to conform with the Socratic and Teacher-Tell approaches developed by Maccoby and Comstock. The performance under these conditions was then compared with the learning under a "control" condition wherein the teacher used only the guide provided by the program producer and whatever mode of preparation and follow-up the teacher felt was appropriate. The study is a controlled comparison rather than a true experiment, since a real "control" group -- students who saw all the TV lessons whose teacher had no knowledge of the project -- was missing.** Therefore, the overall design remains the same as the Maccoby-Comstock experiment,

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*Produced by Midwest Airborne Program for Televised Instruction (MPATI).

**Although some effort was made to locate a number of classes that would meet these viewing and awareness criteria, only one was found that had missed fewer than two lessons in the unit.

except that only one subject area was covered and the duration of the project was six weeks (12 lessons) rather than four weeks (8 lessons). The same hypotheses were tested under normal California public school conditions. The hypotheses were tested by simple analysis of covariance using a posttest score as the dependent variable and pretest/intelligence scores as covariates.

PROCEDURE

Fifth grade teachers from three cooperating school districts within Santa Clara County, California, were assigned randomly to one of the three utilization methods: Socratic, Teacher-Tell, and Ad Hoc. The actual composition of the three conditions appears in the chart below:

	Socratic	Teacher-Tell	Ad Hoc	Total
Number of Teachers	11	9	8	28
Number of Students	318	271	228	817

These teachers were then brought to the County Office of Education for one hour of training in the utilization method of their respective groups and a brief explanation, plus answers to any questions, about the purpose of the project and how it was organized.

There were three separate training sessions, one for each utilization method. Teachers in both the Socratic and Teacher-Tell groups received special workbooks prepared for the project and based solely on the content of the TV lessons used during the six weeks of the experiment.* These teachers were given instructions on use of the workbooks and a request was made that they be consistent in that use throughout the project. Teachers in the Ad Hoc condition received copies of the guide prepared by the program producer containing new vocabulary words and an outline of contents for each lesson in the series; these guides also suggested related activities from which Ad Hoc teachers were free to choose. No specific instructions about preparation or follow-up were given to the Ad Hoc teachers; they were encouraged to develop a workable plan, to use it consistently, and to give the project director an outline of their methods at the end of the project.

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*These lessons formed a complete unit on insects and animals, but were only a part of the larger fifth grade science series called Exploring with Science.

At the close of the training session, each teacher was given a package of standardized science tests (Stanford Achievement Test in Science, Intermediate II, Form W) to be administered the following week. This pre-test was to serve as an indicator of each student's general science sophistication rather than a measure of knowledge specific to this project. Intelligence scores (California Test of Mental Maturity) were obtained from school records during the course of the study.

Posttests were designed to cover only the material in the TV lessons when it was found that no available standardized measures had a sufficiently detailed section on insects and animals to meet the needs of the project. These posttests were about the same length (55 questions) as the standardized pretests (58 questions) and were administered immediately following the conclusion of the televised unit (six weeks, 12 lessons). Both pretest and posttest were to be completed in the same amount of time, 25 minutes. After the questions were reordered, they were given again, four weeks after the immediate posttest, to measure retention.* Both criterion measures were presented <u>orally</u> to the students since the test information had been obtained in an audio-visual manner. Each student was also asked his father's occupation, if his mother worked, how often his parents helped with homework, how many brothers and/or sisters he had, and if he belonged to any clubs or other organizations. These data were designed to measure how much inflence background variables had on science learning.

During the course of the project, approximately five per cent of the students were dropped for lack of data. The original sample was 864; the final sample was 817. No student was included who failed to take either the pretest or the immediate posttest, although mean class intelligence scores were assigned to students who had no scores on their school records.

Of the 28 participating teachers, 25 were visited by appointment during the TV broadcasts to see how each teacher was using the prepared materials or what utilization procedure had been adopted in the Ad Hoc condition. Allowing for individual differences in interpretation, observers involved in the project saw no teacher who was not following specific Socratic or Teacher-Tell directions, nor any Ad Hoc teacher who was not making some organized attempt at preparing the children for the lesson and building on the content in some fashion after the lesson had concluded.

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*All students took the immediate posttest but only a random subsample of three classes in each utilization group took the retention test; furthermore, teachers were not informed until the day before testing that their students would be tested for retention, in order to avoid preparatory drill.

All teachers made a conscientious effort and all provided the project director with an evaluation of the project and his/her particular utilization assignment at the end of the televised lesson unit.*

*Copies of the student questionnaire and teacher evaluation form, plus samples from the posttest and the utilization guides may be found in the Appendix to this report.

RESULTS

The data collected for 817 students in this project includes the following:

1. Score on Stanford Achievement Test in Science
2. Score on California Test of Mental Maturity
3. Score on specially developed TV science test
4. Information on background variables (father's occupation, mother's working status, frequency of parental help with homework, number of siblings, membership in clubs, or other groups).

In addition, 243 students had retention scores on the specially developed TV science test administered again four weeks after the formal project unit had concluded. These are the data to be presented alone or in combination in these pages.

Differences Between Groups -- Pretest and Intelligence

Covariance is useful when individuals cannot be assigned randomly to treatment groups, as is frequently the case in educational research, and when variables relevant to performance on the criterion can be measured and included in the analysis so as to remove their influences from variation found in the criterion. In this fashion, the investigator can more safely conclude that the experimental treatment was the more proximate cause of observed differences between treatment groups. Pretest and intelligence scores correlated .49 and .37, respectively, with posttest scores; both correlations are significant at well beyond the .001 level. The pretest and intelligence scores for each treatment group and the total group are found in Table 1. These scores show that the children in all treatment groups were at approximately the same level of prior science knowledge but that their mean intelligence scores were significantly different.

TABLE 1

MEAN PRETEST* AND INTELLIGENCE SCORES BY TREATMENT GROUP

	TEST	MEAN	SD	N
SOCRATIC	Pretest	27.66	8.54	318
	Intelligence	114.11	12.83	
TEACHER-TELL	Pretest	26.86	8.54	271
	Intelligence	108.53	14.34	
AD HOC	Pretest	27.07	8.70	228
	Intelligence	110.98	14.58	
TOTAL	Pretest	27.23	8.58	817
	Intelligence	111.38	14.02	

*Pretest had 55 questions, intended for grades 5.5-6.9; few students finished the entire test in the time allowed.

Immediate Posttest Scores

The pretest scores appear to be markedly similar between treatment groups, with intelligence scores accounting for larger differences; a comparison of the unadjusted and adjusted posttest scores reveals that the influence of these variables on posttest performance is one of attenuation. The analysis of variance for raw posttest scores indicates highly significant differences between treatment groups; while the covariance analysis is still significant, the between-groups differences are of lesser magnitude. Table 2 reports this comparison.

TABLE 2

SIMPLE ANALYSES OF VARIANCE FOR UNADJUSTED AND ADJUSTED POSTTEST SCORES -- ADJUSTMENTS MADE WITH PRETEST AND INTELLIGENCE SCORES AS COVARIATES (N=817)

	SUM OF SQUARES	df	S^2	F	p
Unadjusted Posttest					
Between groups	502.85	2	251.42	7.65	<.001
Within groups	26736.85	814	32.85		
Total	27239.70	816			
Adjusted Posttest					
Between groups	236.21	2	118.10	4.82	<.01
Within groups	19877.98	812	24.48		
Total	20114.19	814			

With these significant results, it is appropriate to compare the adjusted mean scores between treatment groups. In Table 3, the Socratic method proves superior to both the Teacher-Tell and Ad Hoc methods. The data support both hypotheses of this study.

TABLE 3

COMPARISON OF ADJUSTED MEAN POSTTEST SCORES BETWEEN TREATMENT GROUPS

GROUPS COMPARED	UNADJ MEAN	ADJ MEAN	SE DIFF	z	p	N
Socratic	40.35	40.06	.431	2.42	<.01*	318
Ad Hoc	38.95	39.02				228
Socratic	40.35	40.06	.412	2.85	<.01*	318
Teacher-Tell	38.61	38.89				271
Teacher-Tell	38.61	38.89	.446	.28	n.s.	271
Ad Hoc	38.95	39.01				228

*One-tail, according to hypotheses.

It is interesting to look at the relationship of prior science information and intelligence scores to learning from the TV lessons. For the total number of subjects and within the treatment groups, the multiple and partial correlation coefficients have been computed for the pretest and intelligence measures as predictors of learning on the immediate posttest. As Table 4 shows, the pretest (science sophistication or prior knowledge) is a far better predictor of learning from the TV science lessons when intelligence is controlled, although the zero-order correlations of both variables with the posttest score are significant at the .001 level. For the whole group, the two variables predict 26 per cent of the variance in science learning, while the amount of variance predictable within treatment groups ranges from 19 to 29 per cent.

TABLE 4

MULTIPLE AND PARTIAL CORRELATION COEFFICIENTS OF PRETEST AND INTELLIGENCE WITH IMMEDIATE POSTTEST FOR TOTAL GROUP AND TREATMENT GROUPS

GROUP	Multiple r	Intelligence removed	Pretest removed	N
Total	.511	.377	.167	817
Socratic	.541	.353	.233	318
Teacher-Tell	.530	.436	.140	271
Ad Hoc	.444	.351	.065	228

These correlations also indicate that prior knowledge of science is a meaningful grouping variable for student placement in order to maximize science learning within classes. Practically, however, grouping is not done on one subject variable, nor were there differences on this variable between treatment groups at the start of the experiment. Grouping in the schools is based primarily on intellectual potential over many subject areas, and data for this study show differences on this variable between treatments at the start of the experiment. In order to account for grouping by intelligence score, a two-way analysis of variance (treatment-by-intelligence) was performed on the unadjusted posttest score, dividing intelligence into high, medium, and low sections with equal numbers of students. The median intelligence score for the total group was 112, the mean 111, the range 59-170; the distribution was approximately normal. Using unadjusted posttest scores as the dependent variable, Table 5 indicates that brighter students learned more, that the Socratic method was generally better than both other methods, but that certain intelligence groups learned more under one method than under another.

TABLE 5

TWO-WAY ANALYSIS OF VARIANCE FOR UNADJUSTED
POSTTEST SCORES BY INTELLIGENCE AND TREATMENT GROUPS (N=817)

SOURCE	SUM OF SQUARES	df	S^2	F	p
Intelligence groups	3101.39	2	1550.69	52.95	<.001
Treatment groups	502.85	2	251.42	8.58	<.001
Interaction	385.24	4	96.31	3.29	<.01
Within groups	23664.95	808	29.29		
Total	27239.69	816	33.38		

When the means of different treatment groups are compared within intelligence groups, the data in Table 6 show that for children in the high group (117-170), Socratic utilization increases their learning. The mean differences within the high group between Socratic and Ad Hoc or Ad Hoc and Teacher-Tell indicate the Ad Hoc utilization method combines both approaches and is not significantly different from either for these bright children. For children in the middle range (106-117), however, both Socratic and Teacher-Tell are significantly different from Ad Hoc, although not different from one another. Children with lower intelligence scores (59-106) performed somewhat better under the Ad Hoc condition, although none of the groups was significantly better than any other.

TABLE 6

COMPARISON OF UNADJUSTED MEAN POSTTEST SCORES
WITHIN INTELLIGENCE GROUPS

INTELLIGENCE GROUP	GROUPS COMPARED	MEANS	SE DIFF	z	p	N
HIGH (117-170)	Socratic	42.39	.73	2.79	<.01	131
	Teach-Tell	40.35				72
N=272						
	Socratic	42.39	.75	1.51	n.s.	131
	Ad Hoc	41.26				69
	Teach-Tell	40.35	.87	1.01	n.s.	72
	Ad Hoc	41.26				69
MED (106-117)	Socratic	40.57	.74	.67	n.s.	107
	Teach-Tell	40.07				82
N=273						
	Socratic	40.57	.78	2.78	<.01	107
	Ad Hoc	38.40				84
	Teach-Tell	40.07	.83	2.01	<.05	82
	Ad Hoc	38.40				84
LOW (59-106)	Socratic	36.72	.91	.22	n.s.	80
	Teach-Tell	36.52				117
N=272						
	Socratic	36.72	.93	.76	n.s.	80
	Ad Hoc	37.43				75
	Teach-Tell	36.52	.81	1.12	n.s.	117
	Ad Hoc	37.43				75

Retention Test Scores

The retention measure was exactly the same test as the posttest immediately following the classroom exposure to the TV lessons, except that the questions were re-randomized. The test-retest correlation was .688; the mean retention score for the sub-sample of 243 was 40.03, slightly higher than the immediate post-test mean of 39.38. Again, the analysis of covariance was used to account for pre-existing differences in student abilities. Table 7 shows that there are significant differences in learning between utilization methods.

TABLE 7

SIMPLE ANALYSIS OF COVARIANCE FOR RETENTION SCORES WITH PRETEST AND INTELLIGENCE SCORES AS COVARIATES (N=243)

SOURCE	SUM OF SQUARES	df	S^2	F	p
Between groups	187.80	2	93.90	3.69	<.05
Within groups	6044.84	238	25.39		
Total	6232.64	240			

A comparison between adjusted mean scores for different utilization groups shows that the Socratic method remains superior to the Ad Hoc method, but that it is not significantly different from Teacher-Tell, nor is Teacher-Tell much different from Ad Hoc. Table 8 reports these results.

TABLE 8

COMPARISON OF ADJUSTED MEAN RETENTION SCORES
BETWEEN TREATMENT GROUPS

GROUPS COMPARED	UNADJ MEAN	ADJ MEAN	SE DIFF	z	p	N
Socratic	41.41	41.19	.808	2.70	<.01	75
Ad Hoc	39.63	39.00				82
Socratic	41.41	41.19	.825	1.39	n.s.	75
Teacher-Tell	39.19	40.05				86
Teacher-Tell	39.19	40.05	.793	1.33	n.s.	82
Ad Hoc	39.63	39.00				86

Unadjusted retention scores were examined by treatment and intelligence groups, just as were the immediate posttest scores. The intelligence groupings were the same for this analysis as for the posttest, for comparison purposes, although the cells were not equal in the retention test analysis because of subsampling by classes (not necessarily of equal size) and student absences. The results in Table 9 indicate that the significant interaction found with the posttest -- differential effects by intelligence and utilization method -- has disappeared, but the trends remain. Brighter children retain more, yet the mode of utilization seems to make a real difference only in the average or above-average child. The bright children have retained more under both Socratic and Teacher-Tell conditions than in Ad Hoc, while there is a linear difference between treatment groups for average children and no treatment effect at all for the children below average in intelligence. Table 10 reports the comparisons of group means within intelligence levels.

TABLE 9

TWO-WAY ANALYSIS OF VARIANCE FOR UNADJUSTED RETENTION SCORES BY INTELLIGENCE AND TREATMENT GROUPS (N = 243)

SOURCE	SUM OF SQUARES	df	S^2	F	p
Intelligence groups	1170.73	2	585.37	19.90	<.001
Treatment groups	214.58	2	107.29	3.65	<.05
Interaction	125.24	4	31.31	1.06	n.s.
Within groups	6882.80	234	29.41		
Total	8173.48	242	33.77		

TABLE 10

COMPARISON OF UNADJUSTED MEAN RETENTION SCORES WITHIN INTELLIGENCE GROUPS

INTELLIGENCE GROUP	GROUPS COMPARED	MEANS	SE DIFF	z	p	N
HIGH (117-170) N = 66	Socratic	43.22	1.38	.08	n.s.	32
	Teach-Tell	43.10				10
	Socratic	43.22	1.04	2.11	<.05	32
	Ad Hoc	41.12				24
	Teach-Tell	43.10	1.46	1.35	n.s.	10
	Ad Hoc	41.12				24
MED (106-116) N = 83	Socratic	42.36	1.29	.94	n.s.	22
	Teach-Tell	41.15				27
	Socratic	42.36	1.28	1.52	n.s.	22
	Ad Hoc	40.41				34
	Teach-Tell	41.15	1.17	.63	n.s.	27
	Ad Hoc	40.41				34
LOW (59-106) N = 94	Socratic	37.67	2.00	.25	n.s.	21
	Teach-Tell	37.16				45
	Socratic	37.67	2.02	.14	n.s.	21
	Ad Hoc	37.39				28
	Teach-Tell	37.16	1.42	.16	n.s.	45
	Ad Hoc	37.39				28

Other Influences on School Performance

The data for each student included several environment variables which might have influenced school performance independent of intelligence.* Three of these variables were categorical, two continuous; the analysis was different for each type of measure.

For the categorical measures (father's occupation, mother's job status, frequency of parental help with homework), two-way analyses of variance were performed with the unadjusted posttest score as the dependent variable.** Classification variables were treatment group and one of these background influences. These analyses of variance were performed within intelligence groups to control for observed differences at the start of the experiment.

For children of average or below-average intelligence, none of these background variables had any significant effect on learning from the TV series, nor was there any significant interaction between these environmental categories and different utilication treatments. Bright children, however, learned more from the TV science lessons if their fathers were professional men or in business for themselves. Table II reports these data by group means, with the size of each cell n indicated above the mean and the standard deviation below the mean. The F-ratio for the effect of father's occupation (for bright children only) was 5.28, significant at the .001 level (df = 3,253).

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*One class failed to provide names for the students on the questionnaire; that class has been excluded from this analysis.

**Only the posttest scores were used -- rather than repeat the analysis with retention scores -- since all the data could be used and the preceding analysis in this report indicated there was no reason to believe that results would differ with retention scores.

TABLE 11

UNADJUSTED MEAN POSTTEST SCORES BY TREATMENT GROUP AND TYPE OF FATHER'S OCCUPATION FOR CHILDREN WITH HIGH INTELLIGENCE TEST SCORES (117-170)

	TREATMENT			
OCCUPATION	SOCRATIC	TEACHER-TELL	AD HOC	TOTAL
Professional self-employed	60 43.35 3.63	16 41.88 4.40	24 42.79 4.97	100 42.98 4.15
White Collar	32 42.03 5.69	18 40.56 4.31	18 40.78 4.64	68 41.31 5.13
Blue Collar	24 40.50 4.51	27 38.56 5.65	15 41.47 5.56	66 39.92 5.37

Note: Scores of children who failed to report their father's occupation have not been included.

More interesting than the main effect of father's occupation, although the interaction term is not significant, are the mean scores by utilization method within occupational levels. It must be remembered here that these are bright children. For children with professional and white collar fathers, the Socratic method was best, but for children whose fathers had blue collar jobs, the Ad Hoc utilization method was best. It would seem that bright children from less stimulating environments almost have to be brought to learning from television through less direct means than either the Socratic or Teacher-Tell methods provide.

Unfortunately, none of the remaining categorical variables yielded any information to help in determining the role of environment on learning from classroom experiences. One final analysis was performed using the two continuous variables (number of siblings, number of club/organization memberships) as correlates of all the measures of academic potential and performance, except scores on the retention test. The correlations are reported in Table 12.

TABLE 12

CORRELATIONS BETWEEN ACADEMIC AND ENVIRONMENT VARIABLES
(N = 784)

VARIABLES	Pretest	Intell	Posttest	Siblings	Clubs
Pretest	--	.505	.490	-.114	.154
Intell		--	.374	-.074	.109
Posttest	For p=.01, r= .103		--	-.121	.088
Siblings				--	-.075

These intercorrelations show that family size is negatively correlated with the intelligence measure used in this study and with science knowledge, while club membership (mainly Scouts) correlates positively. These correlations, while statistically significant with such a large number of children, should be interpreted with caution because of their small absolute size and the small variability in club memberships reported.* It is possible that children with little peer companionship at home seek that companionship elsewhere, frequently in Scouting at this age; organizations such as Scouts then act to promote acquisition of practical skills, including work in science fundamentals and interest in such things as insects and animals, the subjects of our TV lesson unit.

*The modal reports of club membership were either "Yes, belong to Scouts" or "No, don't belong to any groups." Multiple memberships were infrequent.

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Summary

This study investigated the learning of science from 12 TV lessons by 817 fifth grade students in 14 schools from three districts in Santa Clara County, California, when their teachers (28) were randomly assigned to one of three TV utilization (preparation and follow-up) methods. One of these methods was centered around questions and answers, with immediate knowledge of correct responses (Socratic). Another method was expository, telling the students what they would see and then what they had seen with no question-answer sessions encouraged (Teacher-Tell). The third method acted as a control or "normal" condition where teachers were provided with a program guide and were left to their own devices on preparation and follow-up (Ad-Hoc). The hypotheses tested were:

1. Socratic would prove superior to Ad Hoc utilization because of exposure to more relevant material, feedback of correct and incorrect responses, and insured practice.

2. Socratic would prove superior to Teacher-Tell because of insured perception of content and insured practice of correct responses.

The data collected included: standardized pretest scores of science knowledge, intelligence scores, posttest scores of learning from TV lessons, retention test scores of learning from the TV lessons, and certain background measures for each child (father's occupation, mother's working status, frequency of parental help with homework, number of siblings, number of club or organization memberships). The experiment lasted six weeks. Before the TV lessons began, the pretests were given; the posttests were administered at the end of the TV lesson series and retention tests were given approximately four weeks after the posttests. The background data were gathered on a questionnaire the children completed at the time of the posttest. Intelligence test scores were from school records. Analyses included simple analysis of covariance, two-way analyses of variance, multiple regression, and simple correlation.

The results of the analyses showed no differences between treatment groups on the pretest but some differences on intelligence. The analysis of covariance for immediate posttest scores with pre-test and intelligence as covariates indicated significant overall differences between treatment groups; a comparison of adjusted means supported both hypotheses of the study at the .01 level. Two-way analyses of variance of unadjusted posttest scores

by treatment group and intelligence level showed both significant main effects and a significant interaction. Bright children learned more with some form of participation and less well with the expository method; children in the middle intelligence range did better with methods concentrating on content and no significant differences between methods were found for the less capable students, although these less intelligent children did somewhat better in the Ad Hoc condition.

The analysis of covariance for the retention test scores, again with pretest and intelligence as covariates, revealed significant overall differences between treatment groups. When adjusted means were compared, the second hypothesis was no longer supported, while the first hypothesis retained support. The rank order of adjusted mean scores by treatment group was Socratic, Teacher-Tell, then Ad-Hoc, indicating the importance of involvement with content for retained learning versus some form of participation for immediate learning. The two-way analysis by treatment group and intelligence level showed significant main effects and no interaction, although the students in the low intelligence group did less well than brighter students and equally poorly under all conditions.

The additional data involving background variables showed no influences other than the importance of the father's occupation for brighter children. While brighter children with professional, self-employed, or white collar fathers learned more with Socratic utilization, brighter children whose fathers were blue collar workers learned more with Ad Hoc methods. The number of siblings was negatively related to both academic potential and performance while membership in clubs (mainly Scouts) facilitated learning of science and was most strongly related to the pretest with its wide range of science questions.

Discussion

Before the results can be meaningfully discussed, a fuller description of each utilization method should be presented so that differences attributable to methods in this study can be better understood for practical application.*

The Socratic method was primarily a question-answer preparation and follow-up for the telecasts. Before each lesson, the teacher gave a brief introduction to the material to be covered and then said that the students would be expected to know the answers to several questions after viewing the program. The teacher then asked the questions and could elicit responses from the students

*Samples of materials from the teachers' workbooks may be found in the Appendix.

before the telecast, but the correct response was not reinforced before the lesson was seen. After the telecast, these questions and sometimes others were asked again; students answered and the correct response was reinforced at this time. The time involved in this method of utilization varied with the number of answers each individual teacher wanted to accept before the correct answer was reinforced. The essence of the Socratic method, then, was repeated exposure to relevant material (i.e., increased redundancy), rehearsal of material to be learned, and immediate knowledge of correct response.

The Teacher-Tell method was frankly expository. The teacher read an introductive summary of the day's telecast to students before the lesson, covering the same material as in the Socratic method but in statement form, and read a review summary of the telecast to the students after the lesson had concluded, again covering the Socratic questions in statement form. Teachers were instructed to answer only a limited number of questions and not to encourage the kind of participation designed for the Socratic approach. The time involved in this method was generally less than the amount devoted to the Socratic preparation and follow-up, although some of the summary review statements were long, yet not detailed. The essence of Teacher-Tell was repeated exposure to relevant material, but without overt practice of correct responses.

The Ad Hoc methods varied, by definition, but generally did not incorporate as much concentration on relevant materials as did the Socratic or Teacher-Tell methods. The most frequent example of preparation was a statement of what was to be seen in the day's lesson, accompanied by a brief introduction to new vocabulary words. When the telecast concluded, the teacher would highlight the points from the lesson, receive questions and/or have specially assigned student reports on material from previous lessons.

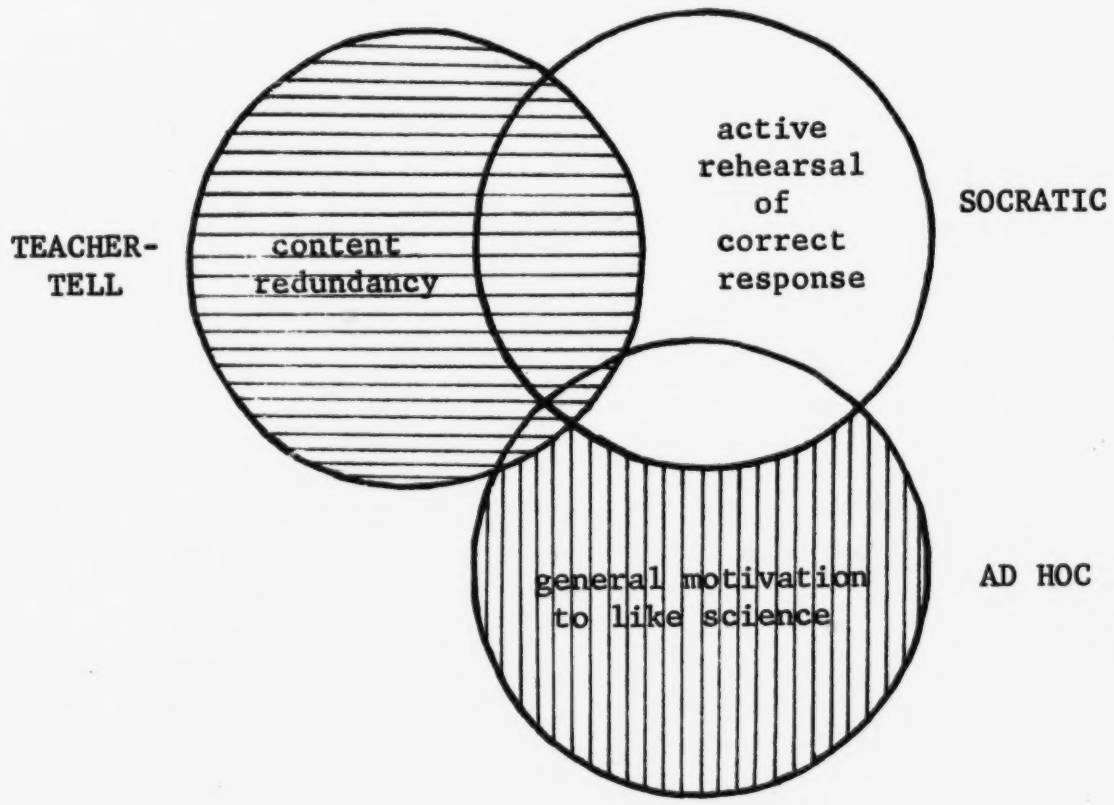
The Ad Hoc utilization procedures generally were not well integrated with each lesson, frequently remained in a tangential though interesting relation to the subject matter in the telecast. At worst, preparation was a hasty tuning of the TV set and there was no follow-up at all if there were no questions volunteered by students. At best, students were prepared for the telecast by being asked what they knew about the subject to be covered, made notes during the telecast on new material they had learned, and wrote short essays on the new learning that had resulted from viewing the lesson. The time involved varied greatly from classroom to classroom. The essence of these methods was motivation to like science as a subject rather than concentration on relevant materials to be learned from the TV lessons by insuring correct reception or reinforcing correct responses.

A comparison of the three utilization methods in diagram form might look somewhat like Figure 1. Teacher-Tell is simple

content redundancy. Content redundancy is common to both Teacher-Tell and Socratic, but Socratic adds active rehearsal of correct responses. Ad Hoc methods tend to overlap both Socratic and Teacher-Tell with less content redundancy than active student participation (although this participation is not necessarily rehearsal of correct responses to be learned from the TV lessons), and they add a peripheral "motivation" ingredient which goes beyond specific lesson content. This characteristic unique to Ad Hoc methods in this study could facilitate learning by generating interest or could confuse the child by presenting too many extraneous pieces of information for efficient learning to take place. The results of this study indicate that both situations occur and that neither is predictable.

FIGURE 1

PICTORIAL REPRESENTATION OF ESSENTIAL ELEMENTS INVOLVED IN DIFFERENT UTILIZATION METHODS



The mean comparisons between utilization methods show that active rehearsal of correct response is the key to immediate learning, but that attention to content redundancy is important for retention. This conclusion is based primarily on the utilization components common to more than one method as described above.

When the effects of the utilization methods for children of different intelligence levels is considered, bright students had higher immediate learning scores when emphasis was placed on participation (in the Socratic method) rather than content (Teacher-Tell) or general motivation (Ad Hoc). Average students performed best when content was emphasized (both Teacher-Tell and Socratic) and below-average students had better, but not significantly better, scores with some motivational support (Ad Hoc).

The comparison of retention scores under different utilization methods simply reduced the magnitude of the posttest score trends within intelligence levels. The greater variability of performance after the intervening four weeks made significant differences harder to obtain and eliminated any effects for children of below-average intelligence. Average and bright students remembered more with some emphasis on content, as indicated by the differences between Socratic and Ad Hoc methods and the comparable retention under Socratic and Teacher-Tell conditions. This interpretation is again based upon the common elements diagrammed in Figure 1.

Unfortunately for the practitioner, none of the background variables had a sufficiently firm relation to learning to allow a realistic appraisal of their influences in the classroom. However, bright children as a subgroup deserve attention here because of their consistently better performance with some method of participation. Children of white collar and professional fathers, where the mode of child-rearing is essentially one of individual participation, had higher scores with Socratic utilization, followed by Ad Hoc, then Teacher-Tell. Blue collar children, from homes where TV is perhaps the dominant means of entertainment rather than a possible source of information, need the extra encouragement to learn from the TV lesson found in the Ad Hoc methods, plus the involvement of active response in the Socratic method. For all three groups bringing different "styles" of learning from home, the content redundancy alone of Teacher-Tell is much less effective.

Although the mean difference on retention scores between Socratic and Teacher-Tell methods was not significant, the majority of evidence in this project indicates that Teacher-Tell is the least effective of the three methods. While variance in effect was predictably greater in the Ad Hoc condition, because of the uncontrolled nature of the treatment and its necessary role in the experiment, students consistently learned less in the Teacher-Tell group. Teachers assigned to Teacher-Tell method were almost universal in their dislike of the constraint on participation and reported that their students did not understand why a dialogue could not take place. This teacher attitude may well have interacted with the more or less sterile character of the Teacher-Tell method to depress motivation and, therefore, learning, but the data do not recommend the use of this method, at least with elementary science telecasts. The experimental results suggest that the

Socratic utilization method (rather than the unique Ad Hoc approaches) provides the best learning "insurance" for elementary science.

The cross-cultural comparison made possible by this replication deserves some brief mention here. In Colombia, the findings of the project after four weeks of teacher participation resembled almost exactly the findings of this study on retention one month following the termination of the experimental treatments. No differences in learning existed between students having Socratic and Teacher-Tell utilization procedures. Why were the immediate posttest results of the replication in the United States so much more dramatic? The level of teacher training itself would seem to be the key. In Colombia, where the traditional instructional procedure was rote drill, teachers could not have been expected to be expert in the Socratic method in such a short period of training by Peace Corps volunteers. It requires skills that Colombian teachers had not previously acquired to provoke discussion and elicit a variety of responses to questions.

Teachers in the United States use these skills -- in greater or lesser degree -- as common teaching techniques and become distressed when, as in this experiment, they are constrained from this type of student-teacher exchange. However, as the Ad Hoc results indicated, this dialogue is not always pertinent, nor is it universally applied as preparation/follow-up for instructional telecasts. The clear-cut results of this replication indicate that skilled, as well as unskilled, teachers can use the Socratic method successfully in the classroom; a better foundation in teaching skills serves only to accentuate the differences between utilization methods.

What of the discrepancy between statistical and practical significance? The means of all methods were within two points of one another, a difference of a mere two test questions, yet mean differences of this size with a large number of students in a variety of classrooms occur, on the average, only once in one hundred times. Are such small differences reliable indicators of a superior teaching method? The data from this experiment say yes. In addition to statistical significance between means provided by the data, the test of the hypotheses in this study was a most conservative one. Only one class was located that could provide an estimate of the "Hawthorne" effect present in the control group for the study; the mean posttest score of this "naive"* class was 13 points lower than the means of the combined 8 classes in the Ad Hoc group that served as a control for the other two methods.

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*They had seen all the telecasts and the teacher was not aware of the project.

While this comparison is gross, it does indicate that an extra effort on the part of the teachers in the control group cannot be ruled out and that the mean Ad Hoc scores may be higher than they would be under "normal" utilization circumstances. These possibly inflated control group scores made the test of the Socratic method even more stringent than any experimental procedures; thus, the results should be considered reliable for application in the classroom.

Recommendations

On the basis of the data from this experiment and the precedent study by Maccoby and Comstock, it is suggested that teachers be taught to use the Socratic method of instructional TV utilization outlined in this report. Teachers should plan to create a beneficial classroom context for instructional television by involving their students with the content to be learned from the TV lesson and encouraging them to respond actively to questions about the content. This type of preparation and follow-up for a TV lesson gives the teacher more "learning insurance" than is likely to be found with any other utilization technique. The chances are better than 90 in 100 that students will learn the TV lesson content well if a Socratic procedure, such as that outlined in this report, is followed.

It is further suggested, although empirical support is lacking at this time, that the effect of this method may be greatly enhanced by its use with more highly complex material to be learned. The material to be learned in this study was simple and a reasonably high level of content redundancy was built into the televised lessons as they came from the producer. Yet, even with these elementary concepts about insects and animals the effectiveness of a question-answer approach, highly integrated with the lesson content, was clear. There is every reason to believe that the effect would be more profound with a subject such as high school physics. Chu and Schramm, in their recent summary Learning from Television: What Research Says comment:

> ". . . It would be reasonable to assume that discussion would be more important where the material taught is quite complicated, or when the students are of a fairly advanced level. . . Even though this explanation seems to make sense, it should be tested in experiments using subjects of the same level, but varying the complexity of the subject matter being taught by television. Then we shall be able to say with greater confidence whether the complexity of the material limits /or enhances/ the effects of discussion." (p. 93)

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APPENDIX A

INSTRUCTIONS: SOCRATIC METHOD

General Statement

The Socratic teacher's manual contains sets of questions which are to be presented to the class for discussion prior to each telecast. As a Socratic teacher, it is your responsibility to read these statements to the students and ask them to respond.

You should acquaint yourself thoroughly with the materials in the manual and be prepared to receive additional questions on matters not covered.

Presentation of the Telecast

1. Motivation. Before the telecast begins, read the introductions and motivating questions, allowing ample time for the students to arrive at answers. It is not necessary for all of the students to agree on one answer, but all students should have the opportunity to express themselves if their answers differ from others. Correctness of student answers should not be determined until after viewing the telecast.

2. View the telecast.

3. Review. Following the telecast, you should present to your class the problems under the review portion. The method of introducing this phase is left to your discretion, but it should be as smooth as possible and consistent for all telecasts.

In this phase, as in the motivational phase, you should read the questions to the class, allowing ample time for all students to respond. During the review, you should indicate the correct responses to the students. You should also be prepared to receive questions for discussion pertaining to matters not specifically covered in the teacher's manual.

TELECAST 9: ANTS AND WASPS

MOTIVATION

Today we are going to learn how ants and wasps live in communities. After you have seen the TV lesson, you should be able to answer questions like these for yourself.

1. Are wasps social or solitary insects?

2. How do the food habits of wasps differ from those of bees?

3. What three types of individuals are found in wasp colonies?

4. Are the cells of a wasp colony composed of the same materials as the cells in a bee community?

5. Do all members of the wasp colony survive through the winter?

6. Are ants social insects?

7. What types of ants are found in an ant colony?

REVIEW

1. What material is used in the construction of wasp colonies and nests?

paper, wood, mud

2. Why do wasps build nests?

to protect the eggs

3. What food is required by a wasp colony?

insects and other small animals, a source of meat

4. Describe the life cycle of a wasp.

Egg, larva, pupa, adult. The conditions under which the larva and pupa develop vary with the different species of wasp.

5. Is there a division of labor in an ant colony?

Yes

6. Ants and wasps undergo what kind of metamorphosis?

complete metamorphosis

7. How does an ant colony differ from a wasp colony?

An ant colony is relatively permanent and survives throughout the winter months. The colony reproduces, stores food, and expands in size. A wasp colony does not survive the winter, so there is no need for wasps to store food.

8. What are the jobs of the worker ants?

caring for the eggs
storing food
feeding the young
defending the nest
enlarging the nest
cleaning the nest

9. Does a worker ant have more than one job?

No, each worker specializes in one job.

APPENDIX B

INSTRUCTIONS: EXPOSITORY OR TEACHER-TELL METHOD

General Statement

The expository method teacher's manual contains abstracts of the television lessons to be studied. As the expository teacher, it will be your responsibility to read the abstracts to the students as written. Should a student have a question, you may answer it, but you should not return the question to the student or the class for discussion. It is necessary that you acquaint yourself thoroughly with the materials in the teacher's manual in order that you may answer the questions asked to the best of your ability.

Presentation of the Telecast

1. Motivation. Before the telecast, read the motivational statements for the lesson. You may answer questions of the students but you should not request questions of them.

2. View the Telecast.

3. Review. Following the telecast, read the review statements to the class as written and answer questions that the students may pose.

Do not ask questions in the form of a review.

TELECAST 9: ANTS AND WASPS

MOTIVATION

Wasps and ants are closely related to the bee, and many of them live in colonies like the bee. In today's telecast we will study about wasps and ants.

You will learn that wasps are flesh-eating, and usually social insects. Their colonies, however, are smaller than those of bees and do not survive the winter. Only the queen lives through the winter to establish a colony the next spring. The wasp nests may be located in a hollow tree, in the ground, in old buildings, or even out in the open. They may be constructed from bits of chewed up wood, of leaves, or even of mud. Each colony will contain three types of adults called the queen, the drone, and the worker. In wasp colonies you will notice a division of labor.

It will be interesting to note that the solitary wasp queen builds each cell and cares for the young.

You will also study ants and learn that the ant colony has a definite division of labor and that the worker ant specializes in one task.

REVIEW

Wasps are insects which are closely related to the bee. Many of them live in colonies which are organized like bee colonies, but which are constructed from other materials. Most wasp colonies are composed of paper made by the wasps from bits of wood. Within these colonies there are queens, drones, and workers. The function of each is very similar to that of the bee, with the exception that the wasp is a flesh-eater, and does not produce and store honey. The wasp colony does not survive the winter. Only the queen hibernates, and establishes a new colony the next spring.

Some wasps are solitary, and build very small nests which are cared for by the queen. These nests may be composed of paper or mud depending upon the species of wasp.

Ants, like bees, live in a very complex community in which there is a division of labor. In the ant colony the laying of eggs is the responsibility of the queen, while the workers are responsible for the rearing of the young, the construction and protection of the nest, and the gathering of the food. Unlike the worker bee, the worker ant specializes in performing one job during its entire life.

The ant colony stores food for the winter and continues to grow for many years.

APPENDIX C

TELECAST 9: ANTS AND WASPS

Objective

To learn that ants and wasps live in communities.

Content

1. Wasps and ants are closely related to bees (in order Hymenoptera).

2. Wasps (There are about 10,000 species of wasps. Unlike bees, wasps feed their young on other insects and spiders.)

a. Some wasps, such as the paper wasp, live in colonies. This wasp chews up wood, mixes it with saliva, and makes layers of cells in nests of paper-like material. These cells are places for eggs which the queen lays. The workers build new cells and take care of the larvae as they hatch. (At the end of summer some eggs become queens, some workers, and other males. The queens and males mate, then all the males and workers die and the queens alone hibernate over the winter to start a new nest in the following spring.)

b. The yellow jacket and white-faced hornet build nests very similar to the paper wasps.

c. The mud dauber, another species of wasp, builds a mud nest under roofs and window ledges.

d. Not all wasps live in colonies. For example, the jug maker wasp is a solitary insect which makes neat vase-like cells, each holding a single egg.

3. Ants are found everywhere in the world wherever they find food (there are 2,500 species of ants). They all live in organized colonies. As in bee colonies, only the queen lays eggs while the other females are workers and do not reproduce. Each worker specializes in one job. Ants have a great variety of methods of gathering food and protecting themselves. One particular ant, whose job it is to block the entrance to the anthill, has a very flat thick head.

Vocabulary

Mud dauber, fire ant, army ant, white-faced hornet, ovipositor.

Related Activities

1. Establish an ant colony.

2. Take a walk near school and find abandoned wasp nests. Mount on peg board so children can compare kinds and identify with make of nest.

3. Find several mud daubers' nests and open them. What type of food did the mother leave for the larvae to use? How is this food kept from spoiling?

4. Look for ant nests in decaying tree stumps or under rocks. Disturb a nest without destroying it and observe the activity.

5. Locate a plant which has many aphids on it. Look for ants and observe their relationship with these aphids. Why are aphids sometimes called "ant cows"?

APPENDIX D

TV SCIENCE TEST
INSTRUCTIONS FOR ADMINISTRATION

This test must be administered between January 10 and 17. The completed forms should be returned to your principal's office; they will be picked up on Thursday, January 18.

The length of the test should be 25 MINUTES.

READ ALL QUESTIONS AND ALTERNATIVE ANSWERS to the students, allowing an appropriate amount of time for decisions. Read each question carefully. DO NOT REPEAT ANY QUESTION.

Students are to write on the tests by marking (X) on the choice they feel is the best answer to each question. Please review the example with them.

Please make sure that each student has at least his name on his test. Place completed tests in the envelope provided and return the envelope to your principal's office.

You will receive test results and other project information as soon as it is available.

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APPENDIX E

TV SCIENCE TEST

NAME_____ DATE_____

SCHOOL_____ TEACHER_____

MARK AN "X" THROUGH THE ANSWER YOU THINK IS BEST FOR THESE QUESTIONS.

EXAMPLE: A fly is
(a) a mammal (X) an insect (c) a reptile

START WHEN YOUR TEACHER TELLS YOU TO BEGIN. YOUR TEACHER WILL READ THE QUESTIONS AND ANSWER CHOICES TO YOU. YOU WILL HAVE 25 MINUTES FOR THE TEST.

1. Which of the following is an adaptation of the beaver?
(a) gnawing teeth (b) furry tail (c) purple feathers

2. The body of a butterfly is
(a) plump and furry
(b) slender and smooth
(c) short and spotted

3. A baby grasshopper is called:
(a) larva (b) nymph
(c) egg

4. Which of the following animals migrate from the mountains to the valleys as winter approaches?
(a) arctic tern (b) elk
(c) trout

5. A moth flies
(a) only at night
(b) only in bright sunlight
(c) both day and night

6. The purpose of the ovipositor in a grasshopper is
(a) to sting (b) to lay eggs
(c) to help fly

7. The beaver's diet consists of
(a) fish (b) bark and plant material (c) insects

8. Camouflage means that
(a) insects look and act like their surroundings
(b) insects fly away when danger is near
(c) insects eat plants

9. Which of the following is an adaptation that enables the owl to secure food?
(a) sharp teeth
(b) silent flight
(c) excellent hearing

10. Young spiders are called _____.
(a) nymphs (b) larvae
(c) spiderlings

11. The bee that takes care of the queen's eggs is called _____.
(a) honeybee (b) drone
(c) worker

12. Moths cause damage only
(a) when they are adults
(b) when they are eggs
(c) when they are larvae

13. The praying mantis is the only insect that can
(a) move its head
(b) fly (c) eat strawberries

APPENDIX F

QUESTIONS ABOUT YOU

1. Where does your father work?

_____

What is his job -- what does he do?

_____

2. Does your mother work? (CHECK ONE)

YES_____ NO _____

3. How often do your parents help you with your school work at home? (CHECK ONE)

VERY OFTEN ____ ONCE IN A WHILE ____ ALMOST NEVER ____

4. How many brothers or sisters do you have? _____

5. Do you belong to any clubs or groups like the Scouts or 4-H? (CHECK ONE)

YES _____ NO _____

What are the names of the groups you belong to (if any)?

_____

_____

_____

_____

_____

APPENDIX G

NAME_____

SCHOOL _____

CRITIQUE

1. In your own words, what do you think this project was about?

_____

2. How would you rate the following: (CHECK ONE FOR EACH)

a. utilization technique instruction workshop	EXCELLENT	GOOD	FAIR	POOR
b. utilization workbook for use in class	EXCELLENT	GOOD	FAIR	POOR
c. TV lessons	EXCELLENT	GOOD	FAIR	POOR

3. Did you have any special problems? (DESCRIBE IN AS MUCH DETAIL AS POSSIBLE)

_____

4. Was there anything you particularly liked about the project or did anything happen in class during the project that you would judge very good?

_____

5. How did your students respond in class to your utilization technique? _____

6. Would you like to suggest changes in your assigned utilization technique? (IF YES, DESCRIBE IN SOME DETAIL WHAT KINDS OF CHANGES THESE WOULD BE) _____

_____

7. Any other comments would be most welcome:

_____

_____

SEW/evc
Santa Clara County
Office of Education
4/19/68 (50)